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AN/APS-96 RADAR MODIFICATION PROGRAM.(U)

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Publication 1711-01-1-1830

AN/APS-96 RADAR MODIFICATION PROGRAM

November 1978
(Report for Period 1 November 1977 through 31 October 1978)

Prepared for
NAVAL AIR SYSTEMS COMMAND
AIR-533317
DEPARTMENT OF THE NAVY
WASHINGTON, D.C. 20361
under Contract N00019-77-C-0516

ARINC RESEARCH CORPORATION

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER 1711-01-1-1830	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) An/APS-96 Radar Modification Program		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER 1711-01-1-1830
7. AUTHOR(s) W. Schulz		8. CONTRACT OR GRANT NUMBER(s) N00019-77-C-0516
9. PERFORMING ORGANIZATION NAME AND ADDRESS ARINC Research Corporation 2551 Riva Road Annapolis, Maryland 21401		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Department of the Navy Washington D.C. 20361		12. REPORT DATE
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) same as abov e		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

UNCLASSIFIED-UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

Same as above

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

on the back

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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This report, covering the period 1 November 1977 through 31 October 1978, summarizes the activites of ARINC Research engineers in supporting the refinement of the designs for kit production at NAC, the test and installation of kits at NAS Miramar, and the familiarization of the Navy technicians with the modified system.

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by

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SUMMARY

During the 12-month period covered by this report, ARINC Research Corporation supported the Naval Air Systems Command and Naval Avionics Center, Indianapolis, in implementing a modification program to improve the reliability, maintainability, and operation of the AN/APS-96 radar. The ARINC Research effort included design and technical support to the NAC engineers in their conversion of the ARINC Research design prototypes to kit production. An ARINC Research representative also evaluated the flight tests of the kit prototypes on selected Navy E-2B aircraft of RVAW-110 at NAS Miramar. He served as a technical focal point to permit the "Tiger Team" of Navy technicians to carry out a highly successful, expedited installation of modification kits. The field representative familiarized the installation team technicians and members of the operating squadron with the modification kit functions while they were training at NAS Miramar. Since this support effort has been very successful, the Navy is considering a recommended extension of the program for the next year, during which the final system modifications will be produced and installed.

CONTENTS

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

An extensive investigative effort by ARINC Research Corporation and Navy engineers identified a specific series of problems in the AN/APS-96 radar system. These problems were the cause of frequent failures, performance problems, and excessive maintenance. Under successive contracts awarded to ARINC Research Corporation, modifications to the radar system were developed to eliminate or substantially reduce the major reliability and maintainability problems. These modifications were tested in the laboratory and in operational aircraft. The prototypes and associated design drawings and documentation were then provided to the Navy for production by the Naval Avionics Center (NAC) and installation by Navy maintenance personnel. The modifications were designed as a series of kits, some with subordinate parts for convenience of production and installation. The kits have been identified as the avionics changes (AVCs) shown in Table 1-1.

During the production engineering and kit assembly process at NAC, ARINC Research provided engineering support to the Naval Air Systems Command (NASC) and NAC in refining the designs to optimize performance on the basis of operational test results and to facilitate production of the kits.

The kits were designed and produced over a span of several years; production and installation are in progress. The incorporation of radar system modifications into aircraft of the fleet presented a problem from the time the first three AVC kits became available. Typically, the kits were to be installed by the supporting Naval Avionics Rework Facility (NARF), but on a timetable that depended on the scheduling of E-2B aircraft and avionics for major repair or rework. This would have resulted in a slow modification process, typically with fewer than 10 assemblies being modified per year.

To accelerate implementation, the Naval Air Systems Command authorized the formation of a special modification team at NAS Miramar to perform these modifications at the AIMD level. The ARINC Research field engineer at NAS Miramar was the coordinator of the activity and became the nucleus of what has been described as the "Tiger Team". This team was composed of individual squadron technicians furnished by the various E-2B squadrons

Table 1-1. AVIONICS CHANGES		
AVC	WRA/SRA Affected	Nature of Modification
1400 Part I Part II	 ME-203 - Power Meter C-3559 - Control	 Provides for accurate rf power output and VSWR sensing and automatic system protection; improved reliability.
1454	AM-2911 - Power Amplifier	Temporary autotune chain fix to improve reliability pending broadband development.
1455	MD-388 - Modulator	Thyratron heat dissipation and trigger improvement and solid-state clipper diode for improved reliability.
1456 Part I Part II	 AM-2910 - Driver Amplifier R-1011 - Receiver	 Broadbanding to eliminate autotune and reduce harmonic output. Transmit Second Mixer temperature reduction; improved reliability.
1457 Part I Part II Part III Part IV	 MD-388 - Modulator C-3387 - Auxiliary Control C-3559 - Main Control TF-381 - Variable Transformer	 Incorporates anomaly-detection circuits into solid-state trigger with fault indications to the operator; provides high-power-section protection from catastrophic failures.
1901 Part I Part II	 TD-454 - Matched Filter CM-273 - Signal Comparator	 Modifies filter components to improve sidelobe suppression and reduce alignment time; replaces obsolescent subtractor tube with integrated circuits; improved AMTI and reliability.
1961 Part I Part II	 R-1011 - Receiver CM-273 - Signal Comparator	 Replaces unstable synchronizer and trigger timer vacuum-tube circuits with solid-state circuits for improved AMTI, radar stability, jitter reduction, and trigger accuracy.
2061	AM-2911 - Power Amplifier	Provides broadband power amplifier, eliminates autotune mechanisms and vacuum capacitors, and improves impedance match to the AM-2910 Driver; permits rapid frequency change.

staging through Miramar, assisted by the NAESU representatives at the AIMD when they were available, with coordination by the ARINC Research field engineer. As a result of this specialized modification effort, it was possible to install selected modifications on a highly accelerated schedule. In the past 12 months, the Tiger Team has installed modification kits in more than 130 assets. The status of the modifications and data on the accomplishment of each pertinent modification are presented in Chapter Three.

1.2 SCOPE OF PROJECT

The contract effort covered by this report extended from 1 November 1977 through 31 October 1978; it provided for continuation of engineering support to NASC and NAC in the production of modification kits. It

also provided for the continuation of in-service operation of modifications to assure their operational viability. As an adjunct to the prototype field evaluation, ARINC Research provided engineering support at NAS Miramar so that the Naval Avionics Center would receive information in a timely manner, permitting them to reconcile any kit problems noted during the installation and to expedite installation of the modification kits.

1.3 REPORT ORGANIZATION

Following the background provided in this chapter, Chapter Two summarizes the engineering support provided to NASC and NAC. Chapter Three summarizes the field activities at NAS Miramar, including the status of the modification effort as of October 1978. Chapter Four provides conclusions and recommendations based on observations made during the contract period.

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CHAPTER TWO

NASC/NAC ENGINEERING SUPPORT

Over the past several years, ARINC Research designed a series of modifications to the AN/APS-96 radar in essentially the sequence shown in Table 1-1. As each of the design efforts was completed, prototypes were fabricated, laboratory testing was performed, flight verification was carried out, and a modification documentation package was prepared. This documentation was delivered to the Naval Avionics Center (NAC) at Indianapolis, Indiana, with the flight-verified prototype. The engineering group at NAC reviewed the design, incorporated changes to facilitate its production or optimize its performance, and developed the complete AVC, including all kit components and changes to Navy documentation for support and training. NAC provided the quantity of kits specified by the Naval Air Systems Command (NASC) to Navy supply at NAS North Island for fleet installation.

During the production engineering process at NAC, questions regarding a particular design feature or detail were referred to the ARINC Research design engineers for resolution. Design alternatives were explored, supplementary documentation was prepared, or specific prototype flight operation results were reconsidered as the production designs were finalized. While flight operations were in progress, timely feedback of information was provided by the ARINC Research engineer monitoring flight performance in the field. In addition, as the modifications were being installed by the Tiger Team, the ARINC Research field engineer supporting the installation effort at NAS Miramar informed NAC of any anomalies noted in the kits. This process permitted the immediate implementation of corrective measures to minimize problems in subsequently delivered kits and to reduce the likelihood of installing discrepant equipment in the operational aircraft.

In the course of this year's effort, some of the engineering support was handled informally during meetings or via telephone, to expedite any changes or other actions needed. Several efforts, however, involved the preparation of specific documentation or data summaries, which were delivered via cover letter at the time they were required. The following paragraphs summarize these activities.

Both NASC and NAC requested and were provided data and observations regarding the application of solid-state replacements for various vacuum tubes in the AN/APS-96 radar. Since the vacuum tubes are becoming more

difficult to obtain and more expensive -- and generally are less stable, with shorter life expectancy than semiconductors -- their replacement with semiconductor devices has become more attractive. As part of the previous contract (N00019-76-C-0169), ARINC Research had investigated the availability of suitable semiconductor devices for use in the AN/APS-96. While several manufacturers had initially developed devices for use as direct vacuum-tube substitutes, all but Teledyne Semiconductor have essentially withdrawn from the marketplace. Teledyne Semiconductor currently offers a family of semiconductor devices designed as replacements for selected vacuum tubes. This family of devices is marketed under the trade name FETRON®.

Investigation showed that, while serving as replacements for vacuum tubes in many applications, the FETRONS (and other, similar semiconductor devices) had to be tailored to some circuit requirements. As a result, the FETRON type TR1201, designed as a replacement for the tube type 6AK5/5654, was not interchangeable for that tube in all circuits. System tests identified a combined total of 42 sockets in the TD-454 and R-1011 in which the FETRON could be used as a direct vacuum-tube replacement. In other AN/APS-96 applications, some circuit modification would have been required to accommodate the FETRONs. Where circuit modifications were indicated, no substitution was made.

Eighty-four FETRONs were installed in two systems, and these have accumulated more than 20,000 device hours with no failure or noticeable degradation in performance. As reported, measurements at NAS Miramar showed temperature reductions on the tube shields of approximately 8°C in sockets where the TR1201 was substituted for the 6AK5/5654. On the basis of projections using limited data and theoretical predictions, Teledyne estimated that the TR1201 exhibits improvement in removal rates ranging from 10:1 to 100:1 over the 6AK5/5654. Their initial estimates also indicated that the unit cost of the TR1201, in quantity, would be less than $20.

The operational test of the broadband modification of the AM-2911 Power Amplifier at NAS Miramar was terminated following the accumulation of 118 operating hours and 388 flight hours, which included carrier qualification operations for aircrew training as well as normal operation. The unit was delivered to NAC so that the engineering for kit production could be initiated. An ARINC Research design engineer visited NAC and conducted a series of tests on the modified power amplifier. The tests at the NAC laboratory verified the same performance achieved in the ARINC Research laboratory nearly a year earlier, before the amplifier was delivered to NAS Miramar for flight evaluation. No adjustments were required. In addition, the ARINC Research engineer demonstrated the modified power amplifier disassembly procedure for NAC personnel in conjunction with an internal inspection of all power amplifier components. The inspection showed all components to be in good condition. No damage or deterioration was observed, and the original tuning adjustments had been maintained within acceptable limits.

CHAPTER THREE

FIELD ENGINEERING SUPPORT

Two aspects of the AN/APS-96 modification program were expedited by the use of ARINC Research field engineering support. The first was design verification. The operational evaluation has proven to be an important element in the design verification process. Use of a field engineer during this evaluation has provided direct, expeditious feedback of information on test progress as well as immediate support where unforeseen problems were encountered.

The second aspect is related to the manner in which this modification effort is being implemented. Originally, the NARF at NAS North Island was to have primary responsibility for installing the radar modifications. The pace of the modifications, when associated with the normal aircraft depot repair cycle, was unacceptable. To expedite the modification process, a special team effort was initiated under the authorization of NASC. While not unique, the concept of a special team was unusual. It utilized the maintenance technicians from the squadrons, as each squadron cycled through NAS Miramar, to install the modification at the AIMD. To expedite the installations and provide continuity as the squadron personnel cycled through as team members, the ARINC Research field engineer served as a source of information and familiarization for the maintenance personnel, furnished technical feedback for NAC and NASC, and assisted in maintaining a continuous flow of equipment through the modification process. Therefore, the ARINC Research field engineer played a key role and provided a continuum of knowledge crucial to the success of the program, which was not available within the military service.

3.1 DESIGN VERIFICATION

As the previous ARINC Research contract (N00019-76-C-0169) for the design of AN/APS-96 modifications was concluded, one major element of that contract effort (the AM-2911 Power Amplifier broadband modification) was introduced into operational verification. The ARINC Research field engineer at NAS Miramar monitored the amplifier's initial performance. During this contract, he continued to maintain close surveillance of modified equipment performance prior to and following each flight series in E-2B 150534 assigned to RVAW-110. Since no official maintenance manuals or documentation were available during the test program, the field engineer used preliminary engineering documentation in supporting the system.

When a connector failure caused a series of secondary system malfunctions in the radar set containing the modified power amplifier, the ARINC Research field engineer immediately provided the design engineers at the ARINC Research Annapolis laboratory the information needed for evaluation and expedited the restoration of the system to service.

FETRON substitutions for vacuum tubes were identified and installed in two systems. Tube shields and component envelopes were instrumented for thermal measurements, and the data were recorded and provided to NASC and NAC to support a fleet replacement effort.

As the initial kits from NAC production were received for installation, the ARINC Research field engineer at NAS Miramar immediately notified NAC of any problems or discrepancies. This rapid feedback permitted the necessary corrective actions to be taken by NAC, thereby preventing subsequent problems that could have occurred after the entire population of kits had been installed.

During the test and installation of the various modifications, the ARINC Research field engineer at NAS Miramar provided orientation briefings to radar operators regarding expected performance. He also briefed Navy maintenance personnel to assure that they would acquire a complete understanding of the modifications during their assignment at the AIMD for the installation effort.

The modification procedure, maintenance instructions, and theory of operation of the Trigger Timer (AVC-1961-II) modification in the CM-273 Signal Comparator were extensively revised on the basis of field review of the documentation at NAS Miramar. The changes were required to assure a more understandable text for use by Navy maintenance technicians. The revised documents were provided to NAC for their use in preparing AVC-1961-II.

3.2 MODIFICATION SUPPORT

The modification program is expediting installation of the avionics changes. The pace of activity during the period 1 November 1977 through 31 October 1978 was maintained by efforts of the ARINC Research resident field engineer, assuring the transfer of a constant supply of kits from the NAS North Island Navy supply office and an identical supply of assets from the various squadron aircraft, from the carrier spares stock, from the CLAMP Bondroom, and from the local rotable pool. Maintenance technicians from VAW-78, -88, -112, -113, -114, -115, -116, and -117, and RVAW-110 participated in the program. This participation gave them an opportunity to become familiar with the modifications as they installed the kits. As a result, the AVCs were incorporated in a timely manner and the technicians acquired an understanding of the characteristics of the modifications. During the past year, the Tiger Team installed more than 130 AN/APS-96 modification kits.

Table 3-1 summarizes the status of assets and kits as of October 1978. Appendix A identifies the AVCs by number and briefly describes their purpose. Appendix B presents a status list of assets by serial number. It should be noted that the assets identified are only those which have been recorded and processed through the NARF at NAS North Island and through the AIMD at NAS Miramar. An occasional unaccounted for asset appears as each ship returns to San Diego and the associated aircraft equipment cycles through the AIMD. When the supply of kits is exhausted in the modification process during the coming months, any unmodified assets should be purged from the inventory to prevent confusion in spares handling.

Table 3-1. AN/APS-96 MODIFICATION SUMMARY

AVC	Kits Produced	Percent Installed	Assets Identified*	Assets Modified	Percent Modified
1400	86	71	83	61	73
1454	96	73	84	70	83
1455	96	65	70	62	89
1456 I	88	39	70	34	49
1456 II	88	52	81	46**	57
1457	79	-	-	-	-
1461†	69	100	92††	69	75
1901 I	84	79	92††	68	74
1901 II	86#	-	-	-	-
1961 I	70#	-	-	-	-
1961 II	70#	-	-	-	-
2061	59#	-	-	-	-

*The number of assets "identified" may not represent the entire population but is the number that appeared on records at NAS Miramar and NAS North Island as of 15 October 1978.

**In addition to the R1011s (WRAs) modified with AVC 1456 II, 11 Second Mixers (SRAs) have been modified and placed in CLAMP.

†Provided by PMTC, Pt. Mugu.

††Of the 92 assets identified, 59 assets are modified with both AVC-1461 and AVC-1091-I.

#Scheduled for delivery by NAC over the next 18 months.

Experience in supporting the aircraft currently in operation suggests that a minimum of two assets for each aircraft would provide a sufficient inventory with current demand. This estimate is based on a complete set of

assets comprising an AN/APS-96 installation in each of the current 38 aircraft, and the following distribution of additional assets: 10 as shipboard spares, 1 at the Training Detachment, 1 at the Air Rework Facility, 8 rotables (4 at each AIMD), 10 in the CLAMP Bondroom, 3 in ASO "A" Stock, and 5 awaiting repair.

CHAPTER FOUR

CONCLUSIONS AND RECOMMENDATIONS

ARINC Research Corporation has utilized its engineering staff and facilities over the past several years to develop a series of modifications to the AN/APS-96 Radar System on the E-2B aircraft. The NAC at Indianapolis continues, as it has for earlier designs, to transform the designs into avionics changes (AVCs). During this transformation process for the changes already implemented, the ARINC Research headquarters and field engineering staff has maintained close liaison with the NAC engineers during the production engineering, kit production, and fleet installation. The close relationship has been successful in expediting implementation of the modifications. Modification of the fleet assets has provided the most dramatic example of the benefit of this close working relationship. Since the NARF at NAS North Island could not modify more than a few assets each year, the establishment of the Tiger Team of Navy technicians, supported by the ARINC Research field engineer at the AIMD at NAS Miramar, expedited the modifications, with more than 130 assets being processed in the past year alone.

The modification kit production will proceed to its conclusion during the coming months. The close working relationship between the ARINC Research, NAC, and NASC engineers and the Tiger Team can provide a continuation of the effective, expeditious process to assure the earliest possible realization of benefits to the fleet.

APPENDIX A

AVIONICS CHANGE DESCRIPTIONS

1. AVC-1400

Redesign of the ME-203 Power Meter was the first of the modifications developed. The original analog power meter design was unstable and therefore subject to frequent operator complaints that could not be corrected by maintenance personnel. Redesign using a digital sample-and-hold circuit provided a stable, accurate, consistent indication of output power, as well as a reliable warning of high VSWR and arcing in the output coaxial transmission line.

2. AVC-1454

The original design of the power amplifier (AM-2911) incorporated a chain-driven autotune mechanism on the input cavity to obtain synchronized tuning of that cavity with the amplifier output cavity. This chain drive quickly became loose after adjustment, causing improper tuning of the input cavity and an attendant reduction in transmitter output power. An inexpensive "quick fix" was developed to maintain chain tension. This fix was implemented as an interim measure during the study of the feasibility of the broadband modification of the power amplifier, which would eliminate the requirement for synchronized tuning and the autotune mechanism.

3. AVC-1455

AVC-1455 was the first of a series to improve the performance of the MD-388 Modulator. In the original design, the hydrogen thyratron and the reverse-current diode exhibited high failure rates because of a marginal input trigger pulse and excessive dissipation. This AVC provides an improved trigger that meets thyratron requirements and a heat-radiating anode extension to reduce thyratron temperature. The vacuum-tube reverse-current diode was replaced with a conservatively rated, reliable solid-state diode stack.

4. AVC-1456

The series of amplifiers providing the rf drive to the AM-2911 Power Amplifier includes the Transmit Second Mixer in the R-1011 Receiver and the AM-2910 Driver Amplifier. Modifications to these amplifiers were developed as separate parts.

Part I provides for broadbanding the AM-2910 Driver Amplifier to eliminate the unreliable and unmaintainable autotune mechanism. It also reduces the undesired second harmonic content in the rf drive to the power amplifier assembly through modification of the output cavity of the fourth stage of the AM-2910 Driver Amplifier. Only minor modification and alignment of the grid cavity was needed. Modification of the output cavity eliminated the variable vacuum capacitor. The modification changed the coupling geometry to prevent operation of this cavity in spurious and harmonic modes and increased the bandwidth through greater loading. A bandpass filter was added, further reducing the second harmonic content to a level more than 50 dB below the fundamental.

Part II of this modification was directed toward reducing the failure rate of the 6442 ceramic triode in the Transmit Second Mixer Assembly, part of the R-1011 Receiver. Excessive envelope and seal temperatures resulted in a high 6442 failure rate. The high envelope temperature was produced by an improper bias condition and ineffective cooling. The modification required a simple substitution of a cathode bias resistor to establish tube operation within grid drive and plate dissipation ratings and the installation of an air deflector to channel the available cooling air across the tube envelope.

5. AVC-1457

AVC-1457, implemented in four parts, is an extension of AVC-1455.

The vacuum-tube trigger generator is replaced by a solid-state trigger generator, which further improves the thyratron trigger as Part I of this modification. More significantly, the modification incorporates an anomaly-detection system that inhibits the generation of a trigger when a malfunction occurs in any of a number of critical high-power assemblies. This feature reduces the likelihood of extensive catastrophic destruction of system components, which had frequently occurred in the original AN/APS-96 design.

Part II of this AVC adds an Operate/Fault indicator and associated wiring to the aft control box, providing an indication to that crew station when the trigger is being inhibited as a result of an anomaly in the high-power sections of the radar.

Part III provides a similar modification to the forward control box.

In Part IV, wiring was added to the variable transformer to automatically reduce power, preventing reapplication of full transmitter power immediately following the detection of an anomaly that interrupts transmitter operation.

6. AVC-1901

The AVC-1901 modifications were the result of an initial effort to improve AMTI reliability and maintainability.

Part I modifies the TD454 Matched Filter. Vacuum tube amplifier drift and the inability to lock the delay-line adjustments made the unit highly susceptible to drift, shock, and vibration. A two- to three-day alignment time was typical with the original TD-454. Poor AMTI and high sidelobes caused frequent operator complaints. To correct the problem, the 5-pole Butterworth filter in the IF Amplifier and Detector Assembly was removed. A 10-pole Bessel filter was installed and a transistor amplifier added to compensate for the Bessel filter attenuation. The adjustable delay lines were replaced with an adjustment-free Wilkinson power divider. The IF Amplifier and Detector assembly was modified to isolate the Computer Detector and Computer Indicator outputs from the AMTI. Phase-reversing switches were incorporated in each of the eight Matched Filter channels. The modifications resulted in long-term filter stability.

Part II is the Subtractor modification. In the CM-273 Signal Comparator, the Subtractor subassembly contained an obsolescent sheet-beam vacuum tube, which, in conjunction with deficiencies in associated circuits, resulted in poor, unstable clutter cancellation. A solid-state Subtractor and associated circuits that eliminated the observed problems were designed.

7. AVC-1961

An extension of the AMTI improvement effort led to the development of the modifications included in AVC-1961.

Part I is a modification of the Synchronizer in the R-1011 Receiver. The original design specifications for the AN/APS-96 were very difficult to meet within the limitations of the vacuum-tube design. This part of AVC-1961 replaces the unstable, marginal vacuum-tube Synchronizer with a solid-state design. The benefits are a substantial improvement in timing-signal-generation accuracy, with attendant reduction in timing-related jitter error, accompanied by improved reliability.

Part II modifies the Trigger Timer. In conjunction with the Synchronizer's performance, the Trigger Timer's performance is reflected on all system timing pulses and, therefore, on clutter cancellation and AMTI performance. At the time of the original AN/APS-96 design, the limitations inherent in vacuum-tube technology associated with circuit deficiencies resulted in marginal trigger-generation accuracy. A solid-state design was developed by utilizing a phase-locked loop and pseudo-random modulation. This design, compatible with the modifications to the synchronizer, Subtractor, and Matched Filter, contributes to a significant and readily apparent improvement in AMTI and target subclutter visibility.

8. AVC-2061

AVC-2061 represents the culmination of an extensive engineering effort to eliminate all chain-drive and gear-drive tuning in the AN/APS-96. The chain- and gear-drive mechanisms have been the source of many operator complaints, system malfunctions resulting in catastrophic failures, and excessive maintenance time spent in adjustments and replacements. Broadbanding the AM-2910 Driver and AM-2911 Power Amplifier has eliminated the autotune system. Two primary considerations were associated with the design: (1) cost factors required that existing driver and power amplifier castings be retained, and (2) the existing power amplifier tube type 8587 would be used. With these constraints, a design was accomplished that provided an asymmetrically switched amplifier output cavity.

All other transmitter rf amplifier cavities in the system are broadbanded across the total frequency range. The power amplifier output cavity operates over the low band (channels 1 through 3) and the high band (channels 4 through 10) by the use of an electro-pneumatic switch arrangement. To accommodate the broadband operation of the power amplifier and its "piggyback" driver, modifications are also included in the MD-388 Modulator. These modifications include a second thyratron with alternative switching logic to reduce thyratron operation to within ratings. A new pulse-forming network, charging reactor, and pulse transformer, as well as an additional pulse transformer for the "piggyback" amplifier, are included. The liquid cooling system was modified to provide coolant to the "piggyback" amplifier, the power amplifier pulse transformer, and the pulse-forming network. These changes, in conjunction with the radar-monitoring and high-speed protection circuits added in the other AVCs, are designed to improve reliability and substantially reduce maintenance manpower requirements.

APPENDIX B

AN/APS-96 COMPONENT MODIFICATION STATUS

The status of AN/APS-96 component modifications is shown in Tables B-1 through B-5.

Table B-1. AN/APS-96 COMPONENT MODIFICATION STATUS: AVC-1400, ME-203 POWER METER (86 NAC KITS DELIVERED)

Serial Number	Status	Serial Number	Status
AEN-1	0	XD-9	X
AEN-3		XD-10	0
AEN-4	0	XD-11	0
AEN-5	0	XD-12	
AEN-6	X	XD-13	0
AEN-8*	0 0	XD-14	0
AEN-9	0	XD-15	X
AEN-11*	0 X	XD-16	
AEN-12*	0 0	XD-17	0
AEN-13	0	XD-18	0
AEN-14	X	AYU-1*	0 0
AEN-15	0	AYU-2	0
AEN-16		AYU-3	0
AEN-17	0	AYU-4	0
AEN-18	0	AYU-5	0
AEN-19	0	UY-1	0
AEN-22	0	UY-3	0
AEN-23		UY-4	0
AEN-28		UY-5	0
AEN-29	X	UY-6	X
AEN-31	0	UY-7	
AEN-99	0	BGY-1	0
APZ-2	X	BGY-3	0
APZ-3	0	BGY-4	0
APZ-7		BGY-6	
APZ-8		RG-0002	0
APZ-9	X	RG-0003	0
APZ-10	0	RG-0004	
APZ-11		RG-0005	0
APZ-12		QY-1	0
APZ-13	0	QY-4	
APZ-16		QY-4	0
APZ-18		DKH-1	0
XD-2	0	DBH-1	X
XD-3		DBH-3	
XD-4	0	DBH-4	0
XD-5		LR-8	0
XD-6		LR-9	X
XD-7		LR-10	0
XD-8			

X Modified by Miramar.
0 Modified by NARF NORIS.
* Serial number duplication.

Table B-2. AN/APS-96 COMPONENT MODIFICATION STATUS: AVC-1454, AM-2911/APS-96 AUTOTUNE MODIFICATION (96 NAC KITS DELIVERED)

Serial Number	Status	Serial Number	Status
AEN-1	X	APZ-21	X
AEN-2	X	APZ-22	X
AEN-4	X	APZ-23	
AEN-5*	X 0	AYU-1	X
AEN-9		AYU-2	
AEN-10	X	AYU-4	
AEN-11	X	AYU-7	0
AEN-12	X	XD-1*	X 0
AEN-13	0	XD-3	X
AEN-14	X	XD-4	X
AEN-15		XD-5	X
AEN-16	X	XD-7	X
AEN-18		XD-8	0
AEN-19	X	XD-9	X
AEN-20	X	XD-11	X
AEN-21	0	XD-15	
AEN-22	X	XD-16	0
AEN-24	X	XD-17	X
AEN-25	0	BGZ-1	X
AEN-26		BGZ-2	X
AEN-27	X	BGZ-4	X
AEN-28	X	BGZ-5	X
AEN-30	X	BGZ-7	X
AEN-31	X	BGZ-8	X
APZ-2	0	BGZ-9	0
APZ-3	X	BGZ-10	X
APZ-4	X	BGZ-11	X
APZ-5	X	BGZ-12	X
APZ-7		RG-0001	X
APZ-8		RG-0002	
APZ-9	X	RG-0003	X
APZ-11		RG-0004	0
APZ-12	X	RG-0005	X
APZ-13	X	RG-0006	X
APZ-14	0	RG-0007	0
APZ-15	X	QY-2	0
APZ-16	X	UY-6	X
APZ-17		DKH-1	X
APZ-19	X	LR-4	0
APZ-20		LR-8	X
		U-50	X
		U-74	0

X Modified by Miramar.
0 Modified by NARF NORIS.
* Serial number duplication.

Table B-3. AN/APS-96 COMPONENT MODIFICATION STATUS: AVC-1456, PART I, AM-2910 DRIVER AMPLIFIER BROADBANDING (88 NAC KITS DELIVERED)

Serial Number	Status	Serial Number	Status
AEN-1	X	APZ-16	X
AEN-2		APZ-17	
AEN-3		APZ-18	
AEN-4		APZ-20	
AEN-5		APZ-21	X
AEN-6	X	APZ-27	
AEN-7		AYU-3	
AEN-8		AYU-5	X
AEN-9	X	AYU-6	
AEN-10	X	AYU-7	X
AEN-11	X	XD-1	X
AEN-12	X	XD-3	X
AEN-13		XD-4	X
AEN-14	X	XD-5	X
AEN-15	X	XD-6	X
AEN-16	X	XD-7	
AEN-17		XD-8	X
AEN-18	X	XD-11	
AEN-19		XD-12	X
AEN-21	X	XD-13	X
AEN-23		XD-15	
AEN-25		XD-19	X
AEN-27	X	RG-0001	X
AEN-29		RG-0002	
APZ-1		RG-0003	X
APZ-2	X	RG-0004	
APZ-3	X	RF-0006	X
APZ-4	X	QY-2	
APZ-5		QY-4	X
APZ-7		DBH-1	
APZ-9		DBH-2	X
APZ-10		DBH-3	
APZ-13	X	LR-6	
APZ-14		UY-5	
		X-1	
		U-78	X

X Modified by Miramar.

Table B-4. AN/APS-96 COMPONENT MODIFICATION STATUS: AVC-1456, PART II, R-1011 RECEIVER/TRANSMIT SECOND MIXER (88 NAC KITS DELIVERED)

Serial Number	Status	Serial Number	Status
AEN-1	X	XD-3	
AEN-2	X	XD-4	X
AEN-3		XD-5	X
AEN-4	X	XD-7	
AEN-6	X	XD-8	
AEN-8	X	XD-9	X
AEN-11		XD-10	
AEN-12	X	XD-11	
AEN-14		XD-12	
AEN-15		XD-13	X
AEN-16	X	XD-14	X
AEN-17		XD-16	X
AEN-18	X	XD-17	X
AEN-19	X	RG-0001	X
AEN-20		RG-0002	X
AEN-21		RG-0003	X
AEN-22	X	RG-0004	
AEN-23	X	RG-0005	X
AEN-25	X	RG-0006	
AEN-27	X	RG-0007	
AEN-28		AYU-1	
AEN-29	X	AYU-3	X
AEN-31		AYU-4	
APZ-2	X	AYU-6	X
APZ-3		AYU-7	X
APZ-4	X	UY-1	
APZ-5	X	UY-2	X
APZ-6	X	UY-3	X
APZ-7		UY-4	
APZ-8	X	UY-5	X
APZ-9	X	LR-5	
APZ-10		LR-7	X
APZ-12		LR-9	X
APZ-13	X	LR-10	
APZ-14	X	QY-1	
APZ-17	X	QY-2	
APZ-19		QY-3	X
APZ-20		QY-6	
APZ-21	X	DBH-3	X
APZ-22		G-0007	
APZ-23	X		

X Modified by Miramar.

Note: 11 additional Second Mixer SRAs have been modified and placed as spares in CLAMP.

Table B-5. AN/APS-96 COMPONENT MODIFICATION STATUS: AVC-1461, TD-454 MATCHED FILTER EMI (69 PT. MUGU KITS DELIVERED); AVC-1901, PART I, TD-454 MATCHED FILTER MODIFICATION (84 NAC KITS DELIVERED)

Serial Number	AVC-1461 Status	AVC-1901 Status	Serial Number	AVC-1461 Status	AVC-1901 Status
AEN-1	X	X	APZ-21		
AEN-2	X	X	APZ-23	X	X
AEN-3	X		APZ-24	X	X
AEN-4	X	X	APZ-25	X	X
AEN-5	X	X	APZ-88		
AEN-7	X	X	XD-1		X
AEN-8	X	X	XD-2	X	X
AEN-9	X	X	XD-3	X	X
AEN-10	X	X	XD-4	0	X
AEN-11	X		XD-5	X	X
AEN-12			XD-6		
AEN-13	X	X	XD-8		
AEN-14		X	XD-9	X	X
AEN-15	X	X	XD-10	X	X
AEN-16	X	X	XD-12	0	X
AEN-17	X	X	XD-13	0	X
AEN-18	X	X	XD-15	X	X
AEN-19	X	X	XD-16	X	X
AEN-20	X	X	XD-18	0	
AEN-21	X	X	XD-19		X
AEN-22	X	X	XD-20	X	X
AEN-24	0	X	XD-23	X	X
AEN-26			XD-28	X	
AEN-27	X	X	RG-0002		
AEN-28	X	X	RG-0003	X	
AEN-29	X	X	RG-0004*	X	X
AEN-30			RG-0005		
AEN-31		X	RG-000069	X	X
AEN-34		X	DKH-1	X	
APZ-2	X	X	UY-1		X
APZ-3	X	X	UY-3	X	
APZ-4	X	X	UY-4	X	X
APZ-6	X	X	UY-5	X	X
APZ-7	X	X	QY-1	X	X
APZ-8	X	X	QY-2	0	
APZ-9	X	X	QY-4	X	
APZ-10	X	X	LR-1	0	
APZ-11	X	X	LR-6	0	X
APZ-12	0	X	AYU-2		
APZ-13			AYU-3	X	X
APZ-14	X	X	AYU-4		
APZ-15			AYU-5	X	X
APZ-16		X	AYU-6	X	X
APZ-17		X	AYU-7	0	X
APZ-19	X	X	IO	0	X
APZ-20					

X Modified by Miramar.
0 Modified by NARF.
* Serial number duplication